Remarks:

Rejections under 35 U.S.C. §102

Claims 1, 5-8 and 19 were rejected as anticipated by Sikorsky[1] with reference to Figure 1. Claims 1, 5-6 and 19 have been amended above to recite as a limitation a "digital pressure gauge." Claims 7-8, through their respective dependencies, also now include this limitation. As Sikorsky clearly fails to teach the use of a digital pressure gauge in a helicopter blade pressure measurement device, Applicant respectfully requests reconsideration and withdrawal of these rejections.

Rejections under 35 U.S.C. §103

(A) Claims 2-4, 9-13 and 20-22 were rejected as unpatentable over Sikorsky. Claims 2, 9, 11, 20 and 22 have been canceled. The "digital pressure sensor" limitation has been added through amendment to claims 1, 5-6 and 19. The "battery power source" limitation has been added through amendment to claims 3, 10 and 21.

Applicant respectfully traverses the Action's rejections of claims 2, 9 and 20 (whose limitations now appear in amended claims 1, 5-6 and 19) that are based upon the assertion that it would have been obvious to one of ordinary skill in the art to provide a digital pressure gauge "because of greater reproducibility compared with analog."

Attached hereto in Appendix A is a copy of the User's Guide for the "Digital Pressure Test Gauge J Series" referred to in paragraph 18 of the application specification. There are many advantages of digital sensors such as the J series, in addition to the greater reproducibility, over analog gauges. Some of these are enumerated in the User's Guide, and include:

- rapid (~5 sec) zeroing adjustment;
- self-calibration capability;
- a 4+ digit liquid crystal display; and

[1] Sikorsky Helicopter Technical Manual, A1-H60BB-150-300, submitted by Applicant

- digital refresh of output measurement.

Applicant respectfully submits that the greater reproducibility and other advantages of digital sensors over analog makes them not obvious, as the Action states, but quite oppositely non-obvious. MPEP §2144.06 states that "in order to rely on equivalence as a rationale supporting an obviousness rejection, the equivalency must be recognized in the prior art, and cannot be based on applicant's disclosure or the mere fact that the components at issue are functional or mechanical equivalents." (citing In re Ruff, 256 F.2d 590, 118 USPQ 340 (CCPA 1958)) There is no such recognition offered in the references used to reject the pending claims.

(B) Claims 17-18 were rejected as unpatentable over Kendall[2]. Applicant respectfully traverses this rejection. As discussed above, the use of a digital pressure sensor in measuring blade pressure is not taught or suggested in Sikorski, and it is not taught or suggested by Kendall either. Thus, Applicant submits such use as recited in claims 17-18 are patentable over the cited references.

For at least the above noted reasons, Applicant respectfully submits that pending claims 1, 3, 5-8, 10, 12-13, 17-19 and 21 are in a condition for allowance, and respectfully requests that the examiner reconsider and withdraw all outstanding rejections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the examiner is invited to contact the undersigned at 617-854-4000.

Dated: August 27, 2003

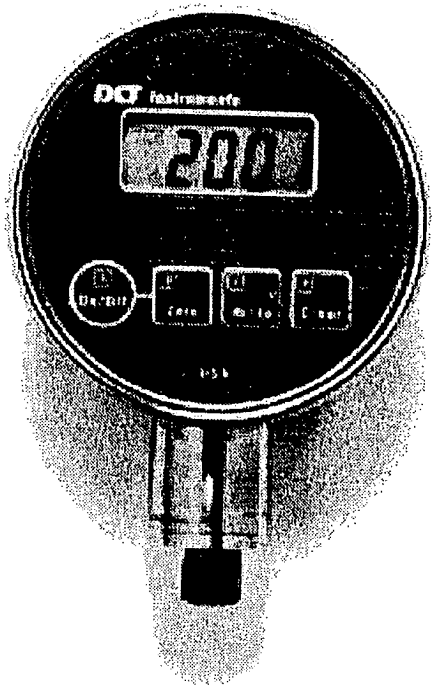
Respectfully submitted,
JULIUS KENDALL, Applicant

By: _____
John A. Hamilton
Reg. No. 48,946
Attorney for Applicant

[2] Julius Kendall, The Entwistle Company (assignee of the present application),Check and Fill Unit Model #ECF-40001 Instruction plate, submitted by Applicant

Appendix A

Digital Pressure Test Gauge
J Series



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WWW: http://www.dctinstruments.com

J Series Digital Gauge User's Guide
DCT Part Number: 77-01349-01
Rev. -: November, 2000

PORTABLE
Model JKW Battery Powered
Model JKT A/C Adapter Powered
Model JKV 11-32 VDC Powered

OUTPUT SIGNALS
Model JSB 4-20 mA (2-wire loop powered)
Model JSE 0-5 VDC
Model JSR 2 Programmable Limits & Relays
Model JSX 0-5 VDC with 2 Programmable Limits

INSTRINSICALLY SAFE
Model PIW Battery Powered

IMPORTANT! IT IS RECOMMENDED THAT YOU READ THIS DOCUMENT THOROUGHLY BEFORE APPLYING POWER TO THIS UNIT. THIS DOCUMENT CONTAINS INFORMATION ON WIRING, CALIBRATION, AND USE OF FEATURES.

TABLE OF CONTENTS

Chapter 1
GETTING STARTED

1.1 Quick Start Guide

1. The instrument comes calibrated from the factory and needs no further calibration.

2. All instruments with optional intrinsic safety must be installed according to the installation drawings. If you are using the intrinsically safe Model PIW instrument, read "INTRINSIC SAFETY" on page 57 before proceeding.

3. For battery powered instruments, **install one or two alkaline batteries** by removing the rear center screw and then the front face plate (See page 2-3).
   If using an **AC adapter** with the Model JKT, connect the adapter into the back of the instrument.
   If using a **Vehicle powered** (Models JSE, JSR or JSX) or **Loop powered** (Model JSB) instrument, use the wiring diagrams in Chapter 6.

4. **Screw the gauge into place** noting the correct threads: (See page 2-1)
   • Up to and including 300 PSI = 1/4 18 NPT [Pipe thread] **(3/4" Hex)**
   • Above 500 PSI = 9/16 - 18 UNF [Straight thread] **(7/8" Hex)**

5. **Push the [On/Off] button.** (See page 2-5)

6. You are now ready to monitor pressure.

1.2 About This Manual

This is the User's Guide for the standard "J Series" Digital Pressure Gauges listed on the inside front cover. As the "J Series" product line expands, other members of the "J Series" are made available with additional features, pressure ports and other options. The differences between these instruments and the standard "J Series" instruments are described in the "J Series User's Guide Supplement", DCT part number 77-01497-00.

Below is a list of some of other members of the "J Series" family that are described in the Supplement.

Model	Description
JD	Wet/Wet differential pressure measurement
JA	.1% Full-scale Accuracy
JP	3A Food/Pharmaceutical sanitary fitting
JH	High Pressure (>10K PSI)
JV	VCR Pressure fitting
JR	Remote Pressure Sensor

As DCT Instruments/Sensotec, Inc. continually improves its products, the information herein is subject to change without notice.

Chapter 2
INTRODUCTION

2.1 Overview

The "J Series" Digital Pressure Test Gauge combines the latest in pressure transducer technology is combined with modern microprocessor electronics to provide a high-accuracy digital readout of process pressure. Stainless-steel construction, high over-pressure protection and a solid-state design give "J Series" instruments a long lifetime with fewer recalibrations.

An easy-to-read digital display provides 4½ digits. The waterproof membrane face uses raised buttons with tactile feedback for ease of setup and operation. Zero adjustment, zero offset/tare, high, low and clear functions are standard on each instrument. Calibration and setup information are stored in non-volatile memory to protect from loss even when power is interrupted. Unauthorized calibrations are also blocked with internal security. Field-selectable units of measure allows one instrument to be re-configured for a variety of tasks.

2.2 Instrument Layout

2.2.1 LCD Display

The 4½-digit liquid crystal display (LCD) readout displays the pressure applied to the instrument, interacts with the user when the instrument is being set up or calibrated, and indicates if there is a problem with the instrument.

When an "J Series" instrument is turned on, it illuminates all LCD segments. Then, the engineering units the gauge will be using appears on the display. Most "J Series" instruments are calibrated in PSI and the instrument has conversion factors for many standard engineering units built in. However, if the instrument displays SPCL (special) it has been specially calibrated to another engineering unit at the factory. In that case, the serial number tag on the top of the instrument will indicate the engineering units being used and the capability to select other engineering units is not available.

After the display of the engineering units, the pressure applied to the pressure port is shown on the display. If the pressure applied to the pressure port is above the instrument's ability to measure, the display will indicate this overrange condition by showing a "1" on the far left hand side of the display. The display will read "-1" if the instrument is underranged.

2.2.2 Low Battery Indicator

On the left side of the display, just above the minus sign, is the low battery indicator (in the shape of an arrow). When the battery voltage is less than 5 volts, the display will be blanked and the low battery indicator will illuminate to indicate that the batteries should be replaced. The low battery indicator can be seen when the instrument is turned on and all segments of the display are momentarily lighted.

When the low battery indicator is illuminated, change the batteries as soon as possible. The instrument will not function if the battery voltage falls below approximately 4 volts.

2.2.3 Decimal Point Position

The decimal point position automatically changes depending upon:

- the user selected engineering units
- the pressure range of the instrument

The decimal point position cannot be changed manually.

2.2.4 Incremental Display Step

The incremental display step is the value which the last digit of the display will change by. This value will either be 1, 2, or 5 display counts. It automatically changes depending upon:

- the user selected engineering units
- the pressure range of the instrument

The incremental display step cannot be changed manually.

2.2.5 Pressure Port Threads

there are two types of pressure ports used, based on the operating pressure of the instrument. Male threads (for ranges below 500 PSI) are 1/4-18 NPT. Female threads (for ranges 500 PSI and above) are 9/16-18 UNF-2B straight thread with SAE spec J514 O-ring boss. An O-ring is needed to seal all instruments with female threads. Optional pressure adapters are listed in the "Accessories" section of this chapter.

2.3 Maximum Safe Overpressure

Maximum safe overpressure is the pressure which the instrument can experience occasionally without loss of accuracy or permanent damage.

Table 1: Maximum Safe Overpressure

Pressure Range (PSI)	Maximum Safe Overpressure (PSI)
0 -1 = 1	10
0 - 5 = 5	25
0 - 15 = 15	75
0 - 30 = 30	150
0 - 50 = 50	250
0 - 100 = 100	500
0 - 200 = 200	1000
0 - 300 = 300	1200
0 - 500 = 500	1500
0 - 750 = 750	1500
0 - 1000 = 1K	2000
0 - 1500 = 1.5K	3000
0 - 2000 = 2K	4000
0 - 3000 = 3K	6000
0 - 5000 = 5K	7500
0 - 7500 = 7.5K	12000
0 - 10000 = 10K	15000

2.4 Front and Side Views

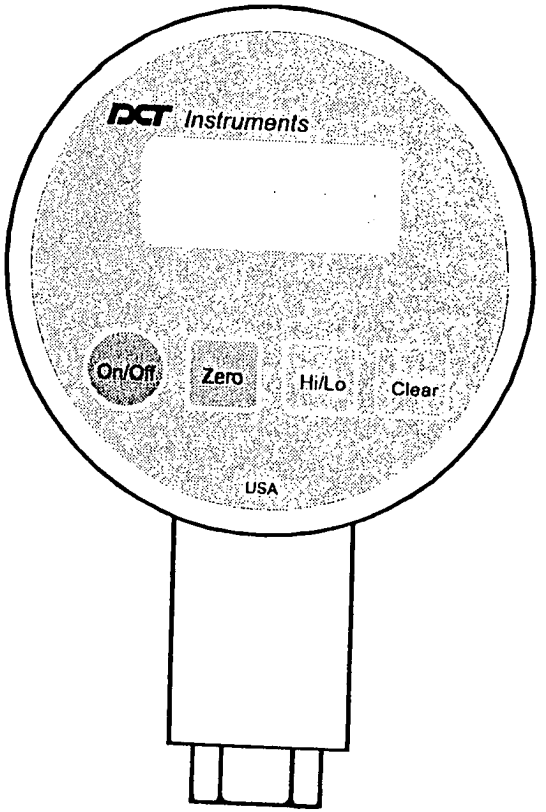


Figure 2-1: "J Series" Front View

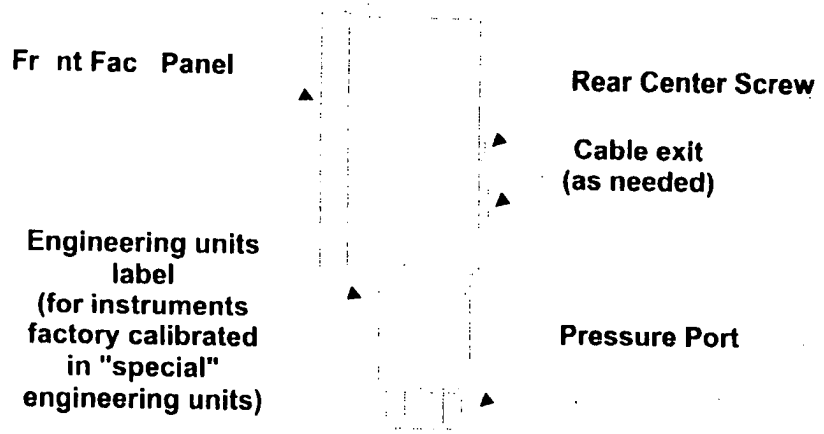


Figure 2-2: "J Series" Side View

2.5 Dimensions

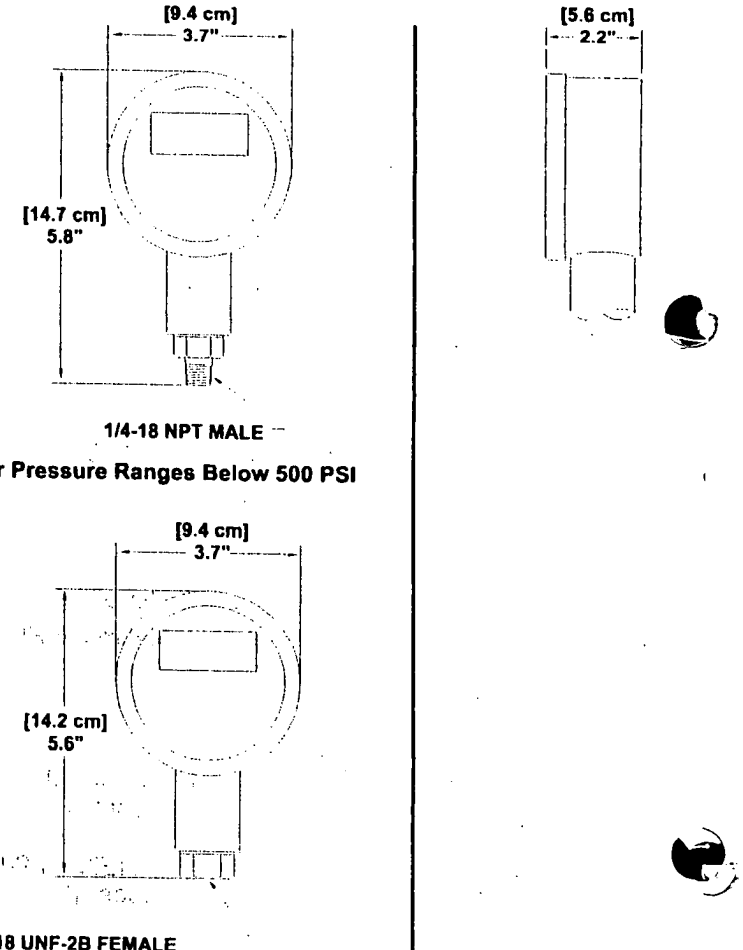


Figure 2-3: "J Series" Dimensions

2.6 Specifications

DCT Instruments continually improves its products, and thus these specifications are subject to change without notice.

Enclosure Rating:	NEMA 2 (standard), NEMA 4 (standard Model PIW; not available on model JKT;optional on other models)
Diameter:	3.7 inches
Linearity and Hysteresis:	.2% of full-scale, linearity and hysteresis (better than test gauge accuracy)
Operating Temperature:	30 to 160 °F (standard), 0 to 180 °F (with NEMA 4 option)
Pressur Ranges 0 to:	1, 5, 15, 30, 50, 100, 200, 300, 500, 750, 1K, 1.5K, 2K, 3K, 5K, 7.5K, 10K PSI
Calibration Engineering Units:	PSI
Built-in Engineering Unit Conversion:	PSI, bar, mbar, inH_2O, inHg, kPa, mmHG, MPa, ftH_2O (field selectable)
Special Engineering Units:	Optional
Display:	4½ digit LCD digits, 0.5 inches high
A-to-D converter sample rate:	7.8 kHz
Frequency Response (-3dB):	.78Hz
Display, Limits and Output Update Rate:	3 per second

Pressure Port:	500 PSI and below: 1/4-18 NPT male 500 PSI and above: 9/16 - 18 UNF-2B female with SAE spec J514 O-ring boss
Power Requirements:	Models JKW and PIW: one or two 9 Volt alkaline batteries Model JKT: 110 VAC@60 Hz adapter (included) Models JKV, JSE, JSR, JSX: 11 to 32 VDC (3 ft. cable included)
Wetted Parts:	Stainless steel
Housing Material:	Stainless steel
High and Low Capture:	Standard, same update rate as display
Zero and Span Adjustment:	Standard
Front Panel Membrane:	Tactile feedback, raised buttons
Calibration Data:	Stored on non-volatile memory chip

2.7 Accessories

ACCESSORY	DCT ORDER CODE	
	< 500 PSI instruments	>= 500 PSI instruments
PRESSURE ADAPTERS (Zinc Plated Steel)		
To 1/4 - 18 NPT female	AD13	AD6
To 1/4 - 18 NPT male	N/A	AD7
To 7/16 - 20 UNF male with 37 degree flare	AD15	AD9
PRESSURE ADPATERS (Stainless Steel)		
To 1/4 - 18 NPT female	SS13	SS6
To 1/4 - 18 NPT male	N/A	SS7
To 7/16 - 20 UNF male with 37 degree flare	SS15	SS9
PANEL MOUNTING RING	MR2	
CARRYING CASE	CC2	
NIST CERTIFICATION	NISTCERTS	

Chapter 3
SET UP

3.1 Installation

When installing the instrument into a process connection, make sure all back pressure is relieved from the system. Make sure that you use the proper fitting to mate with the instrument.

To connect to the pressure fitting, use:

- 1/4-18 NPT for ranges below 500 PSI (3/4" hex wrench)
- 9/16-18 UNF-2B (straight thread) for ranges 500 PSI and above (7/8" hex wrench). An O-ring is needed to seal the connection.

Failure to use the correct fitting will result in leaks. Always use the proper size wrench when tightening the instrument into your system. **NEVER** attempt to tighten the unit by turning the round housing by hand or other means. This may result in permanent damage to the instrument and will render the warranty void.

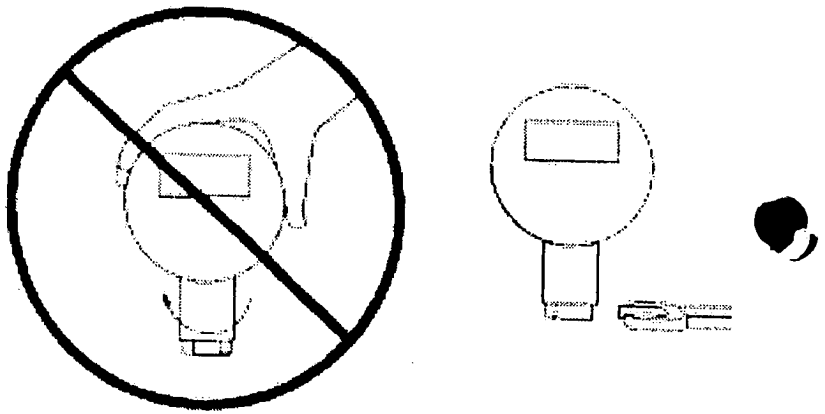


Figure 3-1: Always use a wrench

3.2 Front Panel Rotation

To allow for easy reading and operation regardless of the placement of the process connection, the front face panel can be rotated up to 360 degrees with respect to the pressure port. To re-mount the front face panel into the position of your choice:

1) Remove the center screw on the back of the instrument.
2) Remove the front face panel from the case.
3) Rotate the front face panel into the desired position. Take care not to disconnect the sensor ribbon cable from the electronics.
4) Replace the front face panel. Do not crush or crimp the ribbon cable while replacing the front face panel.
5) Carefully replace the rear center screw.

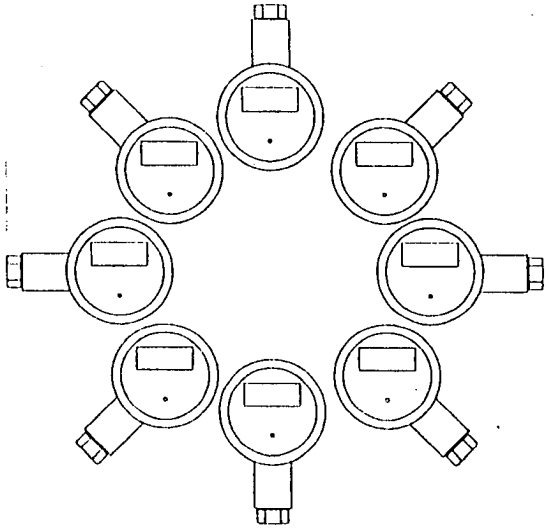


Figure 3-2: Illustration of Front Face Panel Rotation

3.3 Power Supply Options

3.3.1 Battery Replacement

Two nine volt alkaline batteries (NEDA 1604) are recommended for the models JKW and PIW. This is a common type of battery which is available at many stores. With two alkaline batteries, the instrument can operate continuously on for approximately 3 weeks. **Carbon-zinc batteries (sometimes labeled as "general purpose" r "heavy duty") should not be used.** Please note that the temperature specifications of the batteries you purchase may not be the same as those of the instrument.

If two batteries are not available, the instrument will operate with on one alkaline battery installed in either clip. However, this will reduce th continuous operation time to approximately one-and-a -half weeks.

The use of two lithium batteries will allow your instrument to operate continuously for over 6 weeks. **Lithium batteries should not b used in a Model PIW as this will violate the instrinsic saftey rating.**

To install the batteries:

1) Remove the center screw on the back of the instrument.

2) Remove the front face panel from the case.

3) The colored ribbon cable extending from the sensor to the electronics may be disconnected to make the battery installation more convenient.

4) Replace the batteries one at a time, making sure of the correct polarity.

5) Reconnect the sensor cable to the electronics.

Important n te: The brown wire of the sensor cable must be on the right as you face the circuit board, as shown in the figure on page 29. If you connect the sensor cable backwards, the instrument will not operate correctly.

6) Replace the front face panel.

7) Carefully replace the rear center screw.

Note: Calibration and setup values are stored in a nonvolatile memory, and are not lost during battery replacement.

3.3.2 AC Adapter

The wall mount power supply allows the Model JKT to operate from a North American standard 110 VAC, 60 Hz outlet. Connect the plug at the end of the supply's cord into the socket on the rear of the instrument. An optional European 220VAC, 50Hz wall mount supply is also available. See "Power adapter specification" on page 61.

3.3.3 External Power Supply

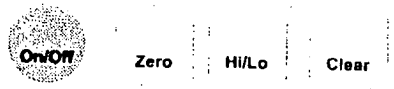
The Models JKV, JSE, JSP and JSX operate from an external DC power source. You will need 11 to 32 VDC at 30 mA.

At the rear of the instrument is a gland fitting which secures the power supply wiring. The wiring code is given below:

Table 2: Model JKV and JIV wiring code

Wire	Designation
Red	(+)Supply (11-32 VDC)
Black	Supply Return

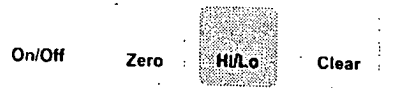
3.4 Turning the Instrument On and Off



Push the [On/Off] button to turn the instrument on or off.

As the instrument turns on, every segment on the display is momentarily lighted. The high/low data values are cleared.

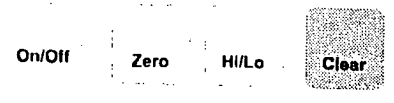
3.5 Zeroing the Display



Hold the [Zero] button until the the display shows "*-0-*" (about 5 seconds).

The instrument will retain this zero value even after the instrument has been turned off.

3.6 Restoring the Calibrated Zero



To restore the zero, first press and hold the [Clear] button, and while holding <Clear>...

... press the [Zero] button. Hold both buttons until the display shows "*-P0-*", then release.

The "calibrated zero" is the zero value of the instrument at the time it was last calibrated. Restoring the calibrated zero can be used to "undo" an inadvertent press of the [Zero] button.

3.7 Reading the High/Low Values

The high and low values are updated at the same rate as the tracking value.

Press the [Hi/Lo] button once to read the highest value since the last time the data was cleared.

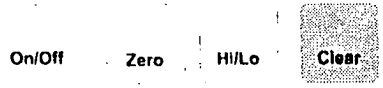
The word "*HI*" and the corresponding value will flash intermittently on the display. This flashing indicates that the instrument is not displaying the "live" tracking value of the process pressure. However, the instrument is still monitoring the process pressure and updating the high and low values.

Press the [Hi/Lo] button a second time to read the lowest value since the last time the data was cleared.

The word "*LO*" and the corresponding value will flash intermittently on the display. This flashing indicates that the instrument is not displaying the "live" tracking value of the process pressure. However, the instrument is still monitoring the process pressure and updating the high and low values.

Press the [Hi/Lo] button a third time to return to the "live" tracking mode. The display will show "- - " to indicate tha the instrument has returned to the "live" tracking mode.

3.8 Clearing the High/Low Values



Press the [Clear] button to erase the high and low data values.

The high and low data values are also cleared when the instrument is turned off.

Chapter 4
CALIBRATION

4.1 Calibration Considerations

In order to obtain optimum performance from the instrument when testing or re-calibrating, DCT Instruments recommends the following:

- Allow a 5-minute warm-up period before testing or calibration.
- The pressure standard you use should be at least 4 times more accurate than the specification of the instrument.

4.2 Required Pressures

In order to re-calibrate the instrument, you must have a precision pressure standard that can produce the zero-scale, half-scale and full-scale pressures for the instrument's range. Examine the table below to determine the three pressures needed to calibrate your instrument. For example, if your instrument has a range of 100 PSIG, your pressure standard must be able to accurately produce pressures of 0 PSI, 50 PSI and 100 PSI.

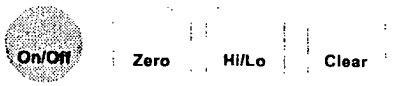
All instruments are calibrated in PSI regardless of the field-selected engineering units. However, if the instrument displays the word "*SPCL*" (special) when it powers up, it has been specially calibrated to another engineering unit. In that case, the serial number tag on the top of the instrument will indicate the engineering units that will be used for re-calibration.

To maintain NIST traceability, DCT Instruments can re-calibrate an instrument for you. NIST certificates may be ordered as a separate accessory for a nominal fee.

Table 3: Required Pressures (all in PSI)

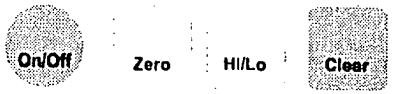
Pressure Range	Calibration Point 0 (zero-scale pressure)	Calibration Point 1 (half-scale pressure)	Calibration Point 2 (full-scale pressure)
1	0	0.5	1
5	0	2.5	5
15	0	7.5	15
30	0	15	30
50	0	25	50
100	0	50	100
200	0	100	200
300	0	150	300
500	0	250	500
750	0	375	750
1K	0	500	1000
1.5K	0	750	1500
2K	0	1000	2000
3K	0	1500	3000
5K	0	2500	5000
7.5K	0	3750	7500
10K	0	5000	10000

4.3 Calibration Procedure



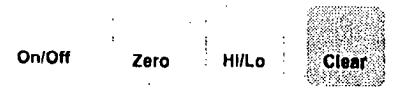
Make certain the instrument turned off.

Open up the instrument by removing the center screw on the bac Next, remove the front face panel. Take care not to break the wir extending from the sensor to the electronics. As indicated on page 2 move the mode jumper from the **"park"** position to the **"calibratio** position.



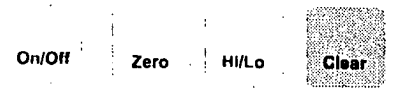
Hold the [On/Off] butt the press the [Clear] butt Th display will momentarily rea "*OP-1*".

The display will begin to alternately flash between the pressure require for calibration point #0 (for example "*000.0*" and "- - - -"). If you wish abandon the calibration procedure, press the [On/Off] button to turn th unit off. Otherwise...



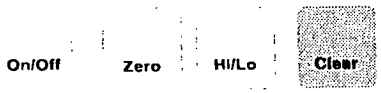
Apply the indicated pressu to the instrument. Pre [Clear] until "*-P-*"is displaye indicating that the reading being stored.

Next, the display will begin to alternately flash between the pressu required for calibration point #1 (for example, "*050.0*") and "- - -



Apply the indicated p to the instrument. Pre [Clear] until "*-P-*" is displaye indicating that the reading being stored.

Finally, the display will begin to alternately flash between the pressure required for calibration point #2 (for example, "*100.0*" and "- - - -").



Apply the indicated pressure to the instrument. Press [Clear] until "*-P-*" is displayed, indicating that the reading is being stored.

When the last pressure point has been entered, the instrument will turn itself off. At this time, the mode jumper must be moved from its "**calibration**" position to its "**park**" position as indicated page 29. Close the unit up and replace the center screw.

Check that the instrument has been calibrated properly by turning it back on and using the pressure source.

4.4 Rear View of Front Face Panel

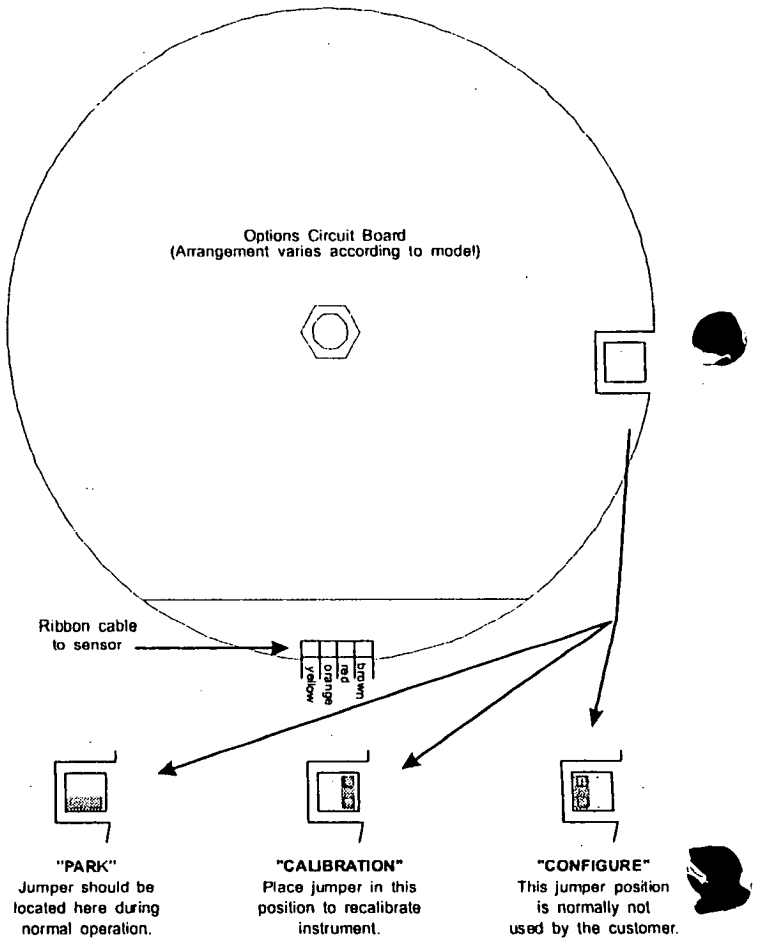


Figure 4-1: Front face panel (rear view), showing mode jumper positions and orientation of sensor cable

4.5 Calibration Error Messages

If unexpected pressures are encountered during the calibration procedure, the instrument will alert the user by flashing the word "*HELP*" and a message number on the display. This indicates that the calibration process cannot continue, and that you must turn the instrument off and recalibrate again when the error has been corrected. A list of error message numbers and their causes is given in "TROUBLESHOOTING" on page 55.

Chapter 5
OUPUT SIGNALS

5.1 Output Signal Overview

The "J Series" family of digital pressure test gauges offers the user n only the digital display but also a variety of output signals for use remote monitoring and data logging applications.

Outputs of 4-20 mA, 0-5 VDC, and dual-limit relays are available a options. Each unit comes completely wired with 3 feet (standard) cable so that the user can power and use the gauge immediate

5.2 Specifications

5.2.1 Limit Relay Option

Applicable Models:	JSR and JSX
Power Required:	11-32 VDC @ 30 mA max.
Number Of Relays:	2 form "C" (i.e. normally open, common, normally closed). One relay for "high" limit, another for "low" limit.
Connection:	Via terminal blocks inside case
Interface:	3 feet of cable with strain relief
Update Rate:	same as display
Relay Contact Rating:	1 Amp @ 24 VDC 0.5 Amp @ 48 VDC Max. switched power: 24W Max. switched voltage: 60V peak-peak
Limit Setup:	Via front panel pushbuttons
Limit Hysteresis:	1% of full scale
Limit Indicators:	Front panel LED "L1" LED is lit when pressure is below the low limit setpoint. "L2" LED is lit when pressure is above the high limit setpoint.

5.2.2 0-5 VDC Output

Applicable Models:	JSE and JSX
Power Required:	11-32 VDC @ 30 mA max.
Output:	0-5 VDC +/- 0.25% of full scale output
Display & Output Zero Adjust:	Via front panel pushbuttons
Output Only Zero Adjust:	Internal Potentiometer
Output Only Span Adjust:	Internal Potentiometer
Operating Temperature:	30 to 160 degrees F
Connection:	Via terminal blocks inside case
Interface:	3 feet of cable with strain relief
Update Rate:	same as display
Max. Output Current:	0.2 mA
Short Circuit Protection:	+Output to -Output
Minimum Output:	At least -2.5% of full scale
Maximum Output:	At least 102.5% of full scale
Reverse Voltage Protected:	Yes

5.2.3 2-wire 4-20 mA Output

Applicable Model:	JSB
Supply Voltage:	2-wire loop, 11-32 VDC (load dependent, see figure 4-1)
Output:	4-20 mA +/- .25% of full scale output
Display & Output Zero Adjust:	Via front panel pushbuttons
Output Only Zero Adjust:	Internal Potentiometer
Output Only Span Adjust:	Internal Potentiometer
Operating Temperature:	30 to 160 degrees F
Connection:	Via terminal blocks inside case
Interface:	3 feet of cable with strain relief
Update Rate:	same as display
Minimum Output::	At least -2.5% of full scale
Maximum Output::	At least 102.5% of full scale
Reverse Voltage Protected:	Yes

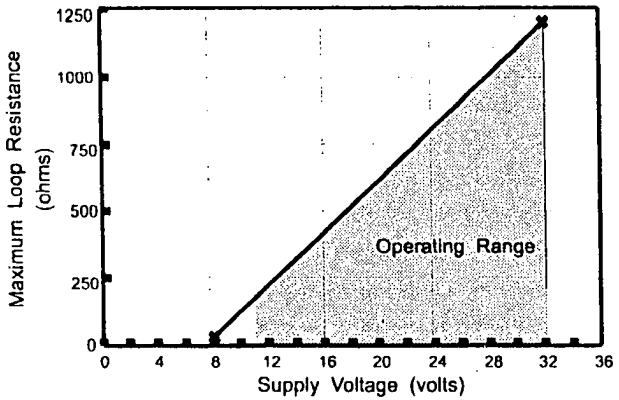


Figure 5-1: Load/power curve for 4-20 mA output

5.3 Wiring Codes And Schematics

5.3.1 Wiring To The Terminal Blocks

Although each digital pressure gauge comes completely wired with 3 feet of cable, it may be desired to remove the cable and directly wire to the terminal blocks on the analog circuit board.

A small flat-blade screwdriver should be used to press the orange opening lever on the terminal blocks when installing or removing wires. To achieve a reliable connection, use either fine stranded or solid stranded wire size 0.5mm^2 or 20 AWG.

The wire **must** be stripped as shown in the "Wire stripping diagram" below.

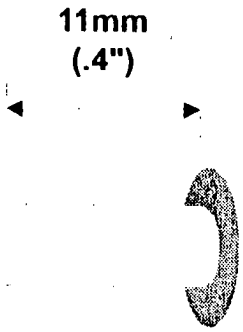


Figure 5-2: Wire stripping diagram

5.3.2 Limit Option

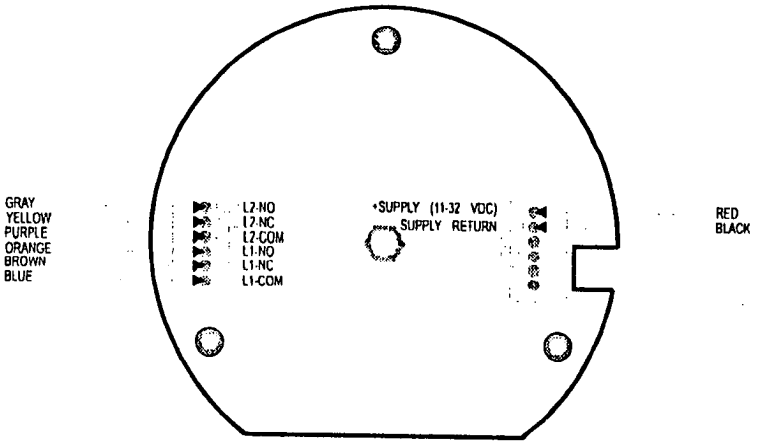


Figure 5-3: Wiring code for limit option

5.3.3 0-5 VDC Output Option

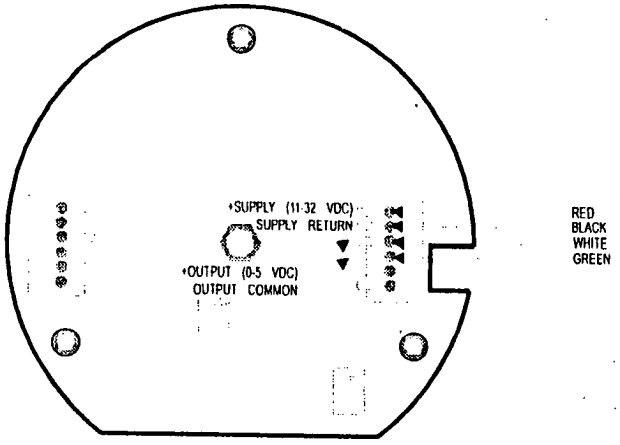


Figure 5-4: Wiring code for 0-5 VDC output option

5.3.4 0-5 VDC Output And Limit Relay Option

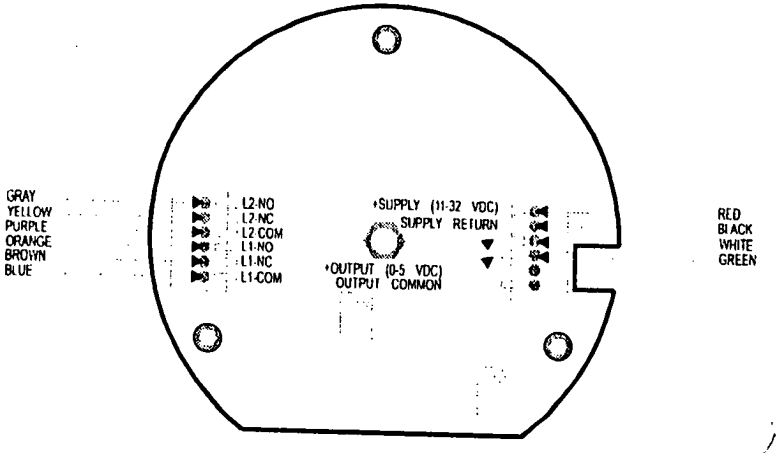


Figure 5-5: Wiring code for 0-5 VDC output and relay option

5.3.5 4-20 mA Output Option

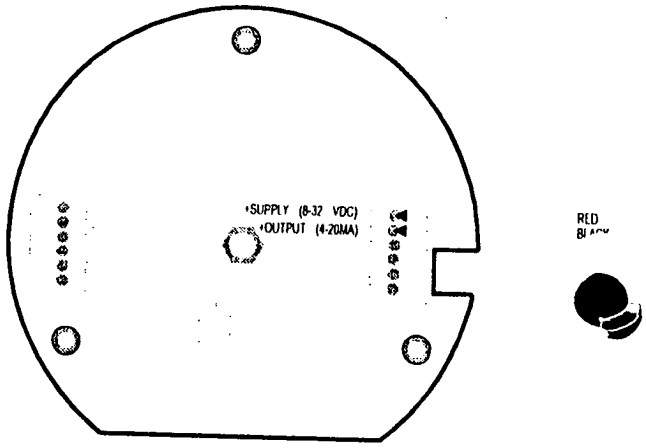


Figure 5-6: Wiring code for 4-20 mA output option

5.4 Explanation Of Limits

Limits allow the instrument to signal both the operator (via the front panel indicators) and other equipment (via the contact relays) that the pressure is within or outside of a specified range. Limit 1 is a "low limit" and Limit 2 is a "high limit."

If the pressure applied to the instrument is less than the setpoint entered for Limit 1, the limit will turn "on." That is,

- the LED indicator on the front panel will illuminate,
- the normally open relay terminal for Limit 1 (L1-NO) will be connected to its common terminal (L1-COM), and
- the normally closed relay terminal (L1-NC) will no longer be connected to its common terminal (L1-COM).

When the pressure rises above the Limit 1 setpoint plus 1% of the range of the instrument, the limit will turn "off." When Limit 1 is turned "off,"

- the LED indicator on the front panel will not be lighted,
- the normally open relay terminal for Limit 1 (L1-NO) will not be connected to its common terminal (L1-COM), and
- the normally closed relay terminal (L1-NC) will be connected to its common terminal (L1-COM).

The 1% specification given above is the "hysteresis" or "deadband" of the J Series instrument limits. Hysteresis prevents the limits from chattering on and off when the pressure is slowly moving through the limit setpoint. For example, if the low limit setpoint is 100 PSI and the range of the instrument is 500 PSI, then Limit 1 will turn on when the pressure drops below 100 PSI and Limit 1 will turn off when the pressure rises above 105 PSI.

Correspondingly, Limit 2 (the "high" limit) will turn "on" when the pressure rises above its setpoint, and turns "off" when the pressure falls below the setpoint minus 1% of the range of the instrument. For example, if the high limit setpoint is 2000 PSI and the range of the instrument is 3000 PSI, the Limit 2 will turn on when the pressure rises above 2000 PSI and Limit 2 will turn off when the pressure drops below 1970 PSI.

5.5 Entering The Limit Setpoints

To change the limit setpoints with the Setup Menu, see "FIELD SELECTABLE FEATURES" on page 43.

5.6 Trimming Of Analog Outputs

Occasionally, the instrument's analog output signal (4-20 mA or 0-5 VDC) may need to be adjusted. The following sequence should be followed by anyone wishing to trim their analog output. The front display of the instrument should be calibrated (see "CALIBRATION" on page 25) before attempting to adjust the analog output. A calibrated standard is required to calibrate the front display, but no pressure source is needed to adjust the analog output.

1. Remove the center screw from the rear of the unit and gently remove the electronics from the housing. Apply power via the integral cable and run to an appropriate instrument.

2. FORCE ZERO - Select the Analog Output Zero Scale ("*A-LO*") menu item by following the directions in "FIELD SELECTABLE FEATURES" on page 43. When the display says "*DONE*", the microprocessor has forced the analog output to 0 VDC or 4 mA.

3. TRIM ZERO - Use the zero potentiometer to trim the analog output zero reading (0 VDC or 4 mA).

4. FORCE SPAN - Select the Analog Output Full Scale ("*A-HI*") menu item by following the directions in "FIELD SELECTABLE FEATURES" on page 43. When the display says "*DONE*", the microprocessor has forced the analog output to 5 VDC or 20 mA.

5. TRIM SPAN - Use the span potentiometer to trim the analog output full scale reading (5 VDC or 20 mA).

6. Repeat steps 2 through 5 until the zero and span readings are trimmed.

7. Turn the unit off, then turn the power supply off and disconnect the "+SUPPLY" of the instrument from the power supply.

8. Insert the electronics back into the housing of the instrument and install the screw into the rear of the device.

9. Connect power supply back to the instrument and apply power verify operation.

10. Trimming of the analog output is now complete.

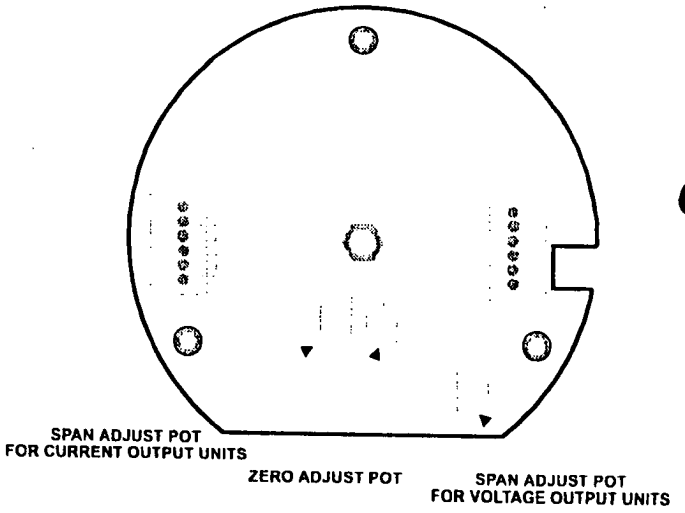


Figure 5-7: Analog circuit board trimming diagram

Chapter 6
FIELD SELECTABLE FEATURES

6.1 Introduction

This Chapter discusses the field selectable features available on the Series" Digital Pressure Gauge. These features can be activat deactivated and modified via the Setup Menu accessed by the fr panel.

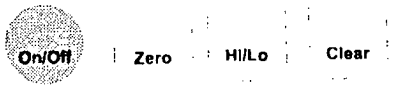
These field selectable features include:

- Setting the low limit setpoint
- Setting the high limit setpoint
- Enabling the automatic power off feature to conserve battery life
- Disabling the front panel buttons
- Changing the engineering units used by the display
- Forcing the analog output to 0 Volts or 4 mA
- Forcing the analog output to 5 Volts or 20 mA
- Displaying the program version

6.2 Setup Menu Operation

All of the field selectable features are accessed via the Setup Menu. This section discusses its operation.

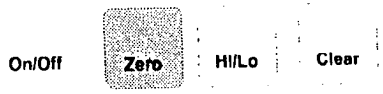
To change a feature with the Setup Menu:



Make sure the instrument is turned off.
Press the [On/Off] button

While unit is checking the display (lighting all LCD segments simultaneously) press and hold down the [Zero] button.

The display now reads "*L-LO*", which is the first item of the Setup Menu. Release the [Zero] button.

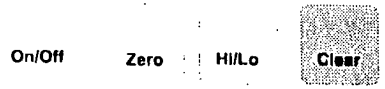


Pressing and releasing the [Zero] button will scroll down through the available Setup Menu items.

The table below provides a list of the items available in the Setup Menu and a brief description of each.

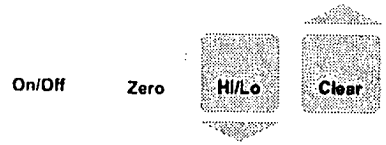
Table 4: Setup Menu Items

Display	Menu Item	Purpose
L-LO	Low Limit setpoint	Change low limit setpoint
L-HI	High Limit setpoint	Change high limit setpoint
EO	Enable Options	Enable Auto-Off feature; Disable front panel buttons
UNIT	Engineering units	Change engineering units used to display pressure
A-LO	Analog Output Zero Scale	Force analog output to 0 Volts or 4 mA
A-HI	Analog Output Full Scale	Force analog output to 5 Volts or 20 mA
VER	Firmware version	Display internal firmware part number and revision



When the menu item you wish to change is displayed, press [Clear].

The display now shows the present setting of that menu item. If you only wish to examine the present setting of the menu item, you c ise the [On/Off] button to turn the instrument off. Otherwise...



Use the [Hi/Lo] and [Clear] buttons to scroll up and down, respectively. Hold a button down to change limit setpoints at a faster rate.

If you wish to abandon the changes you made to this setting, you can use the [On/Off] button to turn the instrument off. Otherwise...

Once the setting you want is displayed, press the [Zero] button to store this setting into memory.

After the instrument stores the setting into memory, the next menu item will be displayed.

6.3 Low Limit Setpoint ("*L-LO*") Menu Item

The Low Limit Setpoint ("*L-LO*") menu item determines the press reading below which Limit 1 will turn "on".

This value is displayed and modifed in the user-selected engineer units specified in the Engineering Units ("*UNIT*") menu item. If the Er neering Units ("*UNIT*") menu item is changed, the value stored in the L Limit Setpoint ("*L-LO*") menu item will automatically convert the new er neering units.

For more information on limit operation, see "Explanation Of Limits" page 38.

6.4 High Limit Setpoint ("*L-HI*") Menu Item

The High Limit Setpoint ("*L-HI*") menu item determines the pressu reading above which Limit 2 will turn "on".

This value is displayed and modifed in the user-selected engineeri units specified in the Engineering Units ("*UNIT*") menu item. If the En neering Units ("*UNIT*") menu item is changed, the value stored in t High Limit Setpoint ("*L-HI*") menu item will automatically convert the ne engineering units.

For more information on limit operation, see "Explanation Of Limits" page 38.

6.5 Enable Options ("*EO*") Description

The Enable Options ("*EO*") menu item controls the features described in the sub-sections below.

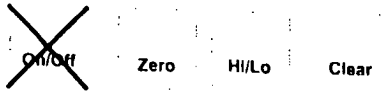
6.5.1 Auto-off Feature

The unit will shut itself off if no buttons are pressed for approximately 1 hour. The unit can also be shut off with the [On/Off] button.

This feature is useful for conserving battery life.

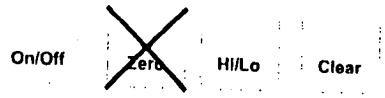
6.5.2 Always-On Feature

The [On/Off] button is disabled and will not shut the unit off. This mode is used so that the high and low capture values, output signals, or limit alarms are not interrupted if an operator tries to shut the unit off during testing or monitoring.



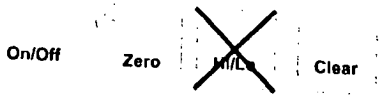
6.5.3 [Zero] Button Disable Feature

This feature disables the ability to zero the display of the instrument. The ability to restore the calibrated zero is also disabled. When the [Zero] button is pressed, the display momentarily reads "*-EO-*" which indicates that the button has been disabled via the Enable Options menu item.



6.5.4 [Hi/Lo] Button Disable Feature

This feature disables the ability to read the stored high and low values on the display. The display will always read the "live" tracking value of the process pressure. When the [Hi/Lo] button is pressed, the display will momentarily read "*-EO-*" which indicates that the button has been disabled via the Enable Options menu item.



6.5.5 [Clear] Button Disable Feature

This feature disables the ability to clear the high and low data valu with the [Clear] button. The ability to restore the calibrated zero is al disabled. When the [Clear] button is pressed, the display momentari reads "*-EO-*" which indicates that the button has been disabled via th Enable Options menu item. **NOTE:** The high and low data values ma also be cleared by turning the unit off and back on, unless the Always on feature is used.

6.6 Enable Options ("EO") Menu Item

To activate or deactivate the features described in the previous section, the setting of the Enable Options ("EO") menu item must be changed. The procedure to change the setting of a menu item is described in the "Setup Menu Operation" section earlier in this Chapter.

The setting value of the Enable Options ("EO") menu item is obtained by adding together the values of the desired options according to the table below.

Table 5: Enable Options ("EO") settings

Feature	Disabled	Enabled
Auto-off	0	1
Always-on	0	2
[Zero] button	4	0
[Clear] button	16	0
[Hi/Lo] button	32	0

For example, to enable the Auto-off feature and disable the [Zero] button enter a setting value of "0005". As another example, to disable both the [Zero] and the [Clear] buttons enter a setting value of "0020".

If the Auto-off and Always-on features are both activated, the unit will behave as follows: The [On/Off] button can turn the instrument on but it cannot turn the instrument off. The only way to turn the instrument off is not to press any buttons for 1 hour.

6.7 Engineering Units ("UNIT") Menu Item

The Engineering Units ("UNIT") menu item determines which un measure are used to display the pressure readings and change th setpoints. Most instruments are calibrated in PSI and the instru has conversion factors for many standard engineering units built ir procedure to change the setting of a menu item is described i "Setup Menu Operation" section earlier in this Chapter.

Note: If the instrument displays "SPCL" (special) when powering has been specially calibrated to another engineering unit. The ab change the engineering units is not available.

The tables below gives a list of the engineering units built inl instrument. Instruments that use the "G" (gage), "A" (absolute (compound) and "D" (differential) reference will use the first Instruments sold with the "M" pressure reference will use the secc

Table 6: Engineering Units ("UNIT") Available Settings

Setting	Engineering Unit / Comment
ADC	for factory use only
PSI	PSI
BAR	bar
MBAR	mbar
TORR	torr
"H2O	inH_2O
'H2O	ftH_2O
"HG	inHg
MMHG	mmHg
KPA	kPa
MPA	MPa

Table 7: Available Units for "M" Pressure Reference

Setting	Engineering Unit / Comment
ADC	for factory use only
PSI	PSI
DUAL	inHg (<0 PSI) or PSI (≥0 PSI)

6.8 Analog Output Zero Scale ("A-LO") Menu Ite

The Analog Output Zero Scale ("A-LO") menu item forces the analog o put to either 0 Volts or 4 mA, then displays "DONE" on the display.

For more information on trimming the analog output, see "Trimming Analog Outputs" on page 40.

6.9 Analog Output Full Scale ("A-HI") Menu Ite

The Analog Output Full Scale ("A-HI") menu item forces the analog o put to either 5 Volts or 20 mA, then displays "DONE" on the disp

For more information on trimming the analog output, see "Trimming Analog Outputs" on page 40.

6.10 Internal Firmware Version ("VER") Menu Item

The Internal Firmware Version ("VER") menu item displays the part number and version number of instrument's operating program. The firmware part number and version number are of the form:

084-1087-01 1.00

Where the "084-1087-01" is the part number, and the "1.00" is the version number.

Since this information is too long to fit on the 4½ digit-display, pressing either the [Hi/Lo] or [Clear] buttons will scroll through this information 4 characters at a time.

Chapter 7
TROUBLESHOOTING

7.1 Introduction

This chapter provides information on correcting common problems tha may be encountered operating and calibrating the instrument.

7.2 Help Message Codes

If the instrument detects a problem during its power-on self-test era tion, or calibration, it will alert the user by flashing the word "H an an error message code number on the display. The instrument cannc continue operation and you must turn the instrument off and correct th error.

- "HELP 01": Calibration error.
  Analog to digital converter overrange.
  One of the pressure points is above the calibration range of the instrument. Or, the sensor cable is not connected properly.
- "HELP 02": Calibration error.
  Analog to digital converter underrange.
  One of the pressure points is below the calibration range of the instrument. Or, the sensor cable is not connected properly.
- "HELP 04": Calibration error.
  The applied pressures at any two calibration points did not r r enough.
- "HELP 23": Self-test error.
  The engineering unit conversion that you selected cannot be rendered on a 4½-digit display. For example, consider the case of an instrument with a range of 10000 PSI. If you were to select mbar ir the Engineering Units ("UNIT") menu item the instrument would signal this error. This is because 10000 PSI equals 689475 mbar

which cannot be shown on a 4½-digit display.

- "HELP 27": Non-volatile memory write error.
  "HELP 28": Non-volatile memory read error.
  "HELP 29": Non-volatile memory verify error.
  "HELP 39": Non-volatile memory version mismatch.
  "HELP 40": Analog-to-digital converter not ready.
  Turn the instrument off and on again. If these problems persist, contact DCT Instruments.

7.3 Troubleshooting Hints

- Verify that the power source is operating correctly. Make sure the batteries are fresh or that the external supply is wired correctly.
- Verify that the sensor cable is connected correctly. The correct orientation of the sensor cable is shown on page 29.
- The sensor and the electronics are a matched set. Do not, under any circumstances, exchange sensor and electronics on two different instruments.
- The [Zero] button must be held down for 5 seconds before the display will be zeroed. This is in order to prevent unintentional zeroing of the display.
- If "-E0-" is displayed when a button in pressed, this indicates that the button has been disabled with the Enable Options ("E0") menu item. See "Enable Options ("E0") Description" on page 48 for more information.

Chapter 8
INTRINSIC SAFETY

8.1 Overview

FM APPROVED

CSA NRTL /C

The Model PIW Digital Pressure Gauge is the intrinsically safe version of the standard J Series instrument. They have been approved by Factory Mutual Research Corporation and the Canadian Standards Association; both are nationally recognized testing laboratories. The PIW instruments are rated Intrinsically Safe for hazardous outdoor locations when installed in accordance with the installation drawings given in this chapter. Additional copies are available upon request.

Intrinsic Safety limits electrical energy passed into a hazardous area in order to prevent ignition.

8.2 Batteries

Only 9 volt alkaline batteries may be used in the PIW Digital Pressure Gauge. Do not use lithium batteries as this will invalidate the approved intrinsic safety.

WARNING: To prevent ignition of a hazardous atmosphere, batteries must be only be changed in an area known to be non-hazardous.

CAUTION: The specific batteries that may be used for CSA approval are indicated on the CSA installation drawing.

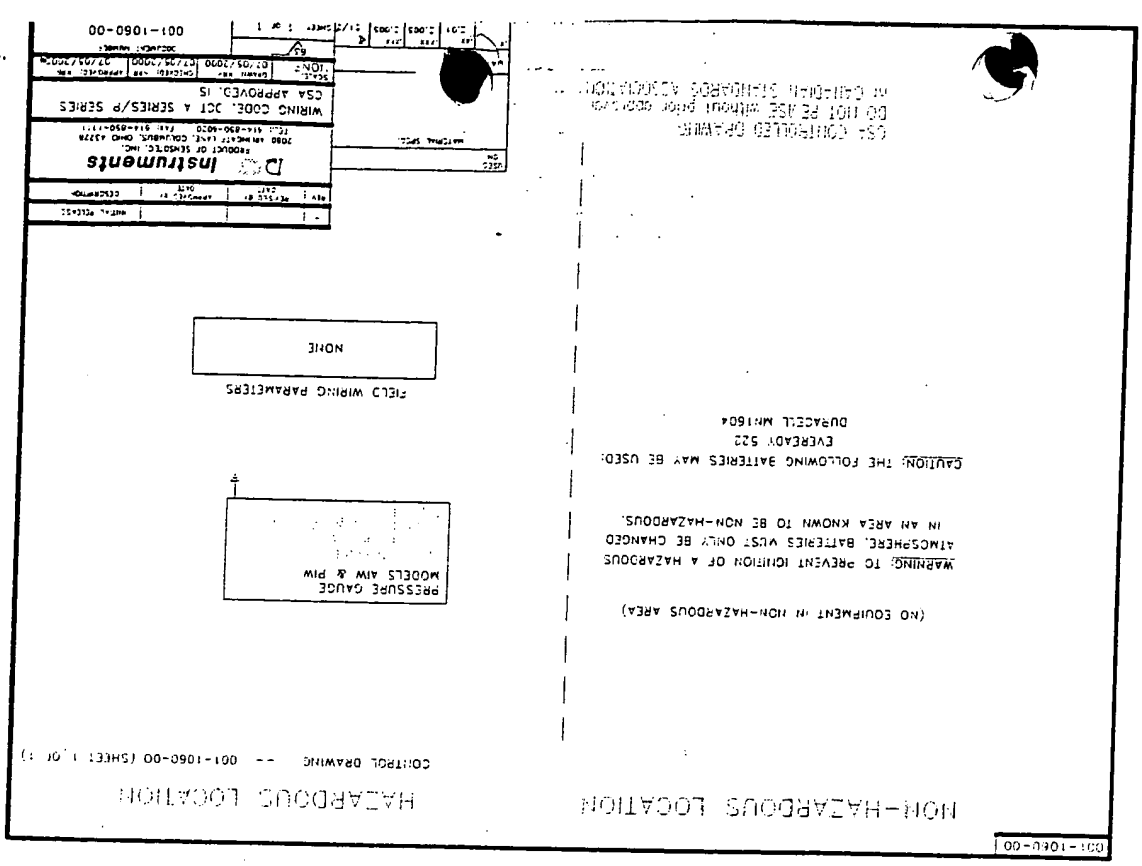


Figure 8-2: CSA Approval Installation Drawing

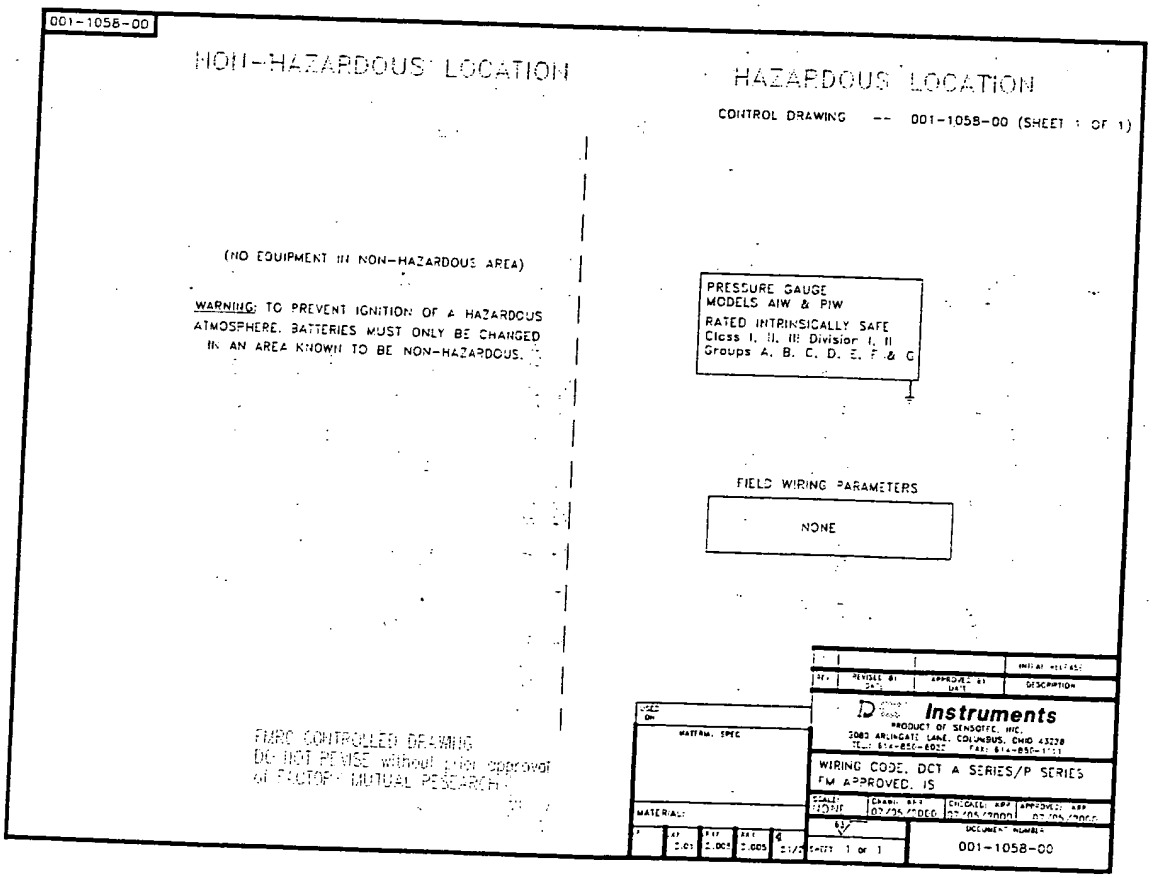


Figure 8-1: FM Approved Installation Drawing

Chapter 9
POWER ADAPTER SPECIFICATION

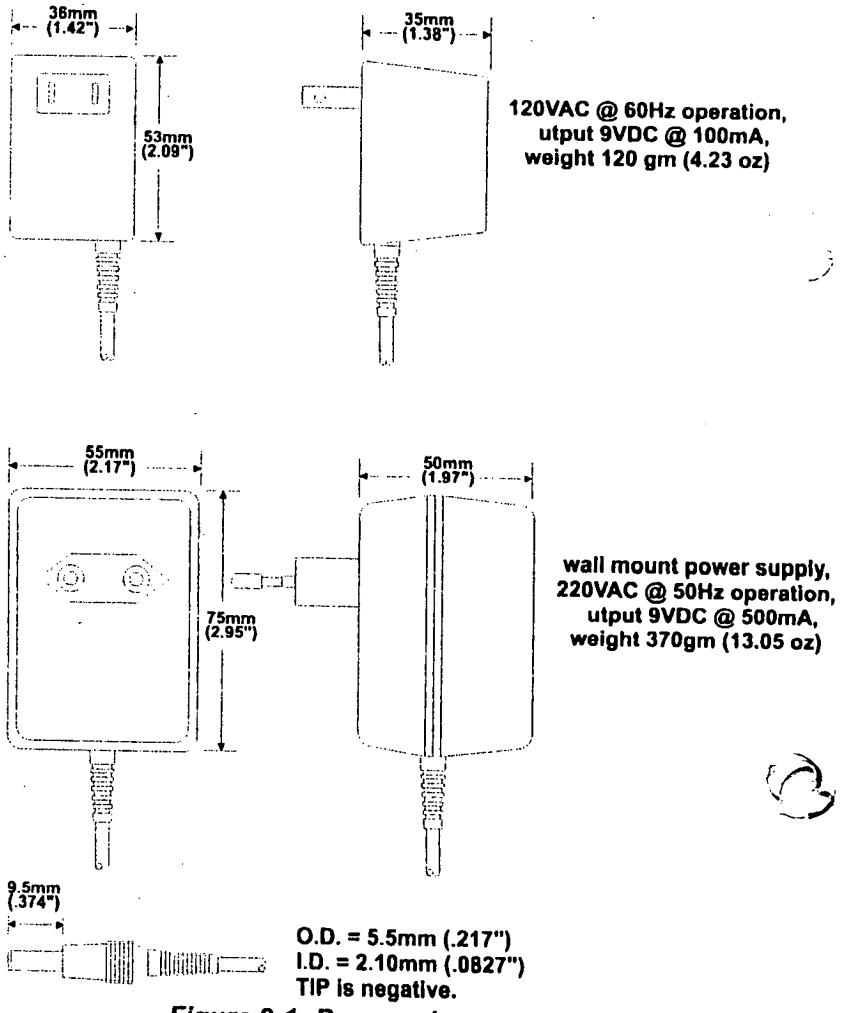


Figure 9-1: Power adapter specification